where near the west coast of England the mean annual secular change in the twenty years has been greater, and near the east coast less than its mean value at Kew; showing that the general direction of the isoclinal lines more nearly approaches a parallelism to the equator now than it did twenty years ago. The ascertainment of the exact value of the secular change at a particular locality by a well-conducted system of periodical observations is the duty of a magnetic *observatory*; the direction of the magnetic lines passing across a country is supplied by magnetic *surveys*; which, for that purpose, ought to be repeated from time to time, as they have now been in this country, at intervals of perhaps twenty or twenty-five years.

It has been imagined that the secular changes of the magnetic elements may be due to some alteration taking place either in the distribution or in the condition of the materials in the interior of the globe. But the regularity and uniformity with which the secular magnetic changes continue through long intervals of time, together with their sudden periodic reversals,—and their corresponding features in the northern and southern hemispheres, which add greatly to the apparent consistency and systematic character of the whole as parts of a uniform general system,—wear more the aspect of effects of some yet unascertained *cosmical* cause. One of the British Colonial Observatories, St. Helena, having the advantage of both a large secular change and a small amount of magnetic disturbance, has afforded a very striking example of the great regularity with which the secular change takes place, maintaining a steady uniformity, traceable not only from year to year, but from month to month, and even from week to week; so that it is not too much to say that, from observations made during a single fortnight, an annual secular change which has existed almost without variation for more than a century, may be ascertained and measured with very considerable precision. (Magnetic Observations at St. Helena, vol. ii. p. ix.)

March 21, 1861.

Major-General SABINE, R.A., Treasurer and Vice-President, in the Chair.

Professor Herman Helmholtz, elected a Foreign Member, was admitted into the Society.

The following communications were read:—

I. "On the Relations of the Vomer, Ethmoid, and Intermaxillary Bones." By JOHN CLELAND, M.D., Demonstrator of Anatomy in the University of Edinburgh. Communicated by Professor HUXLEY. Received February 28, 1861.

(Abstract.)

The author commences by describing the connexions of the vomer in mammalia generally, and states that of these by far the most constant in occurrence and invariable in its nature is one to which he believes he has been the first to attract attention, viz. that by which it comes in contact with the lateral masses of the ethmoid. He states that this connexion is effected by the alæ of the vomer being continued into two laminæ which pass beneath the turbinations of the ethmoid, and are united to the framework of the lateral masses at a point corresponding to the margins of the sphenopalatine foramina. These laminæ he calls the "ethmovomerine laminæ," and for the sphenopalatine foramen he adopts the term "nasal foramen of the palate-bone," because it is not the sphenoid, but the ethmoid, which completes that foramen in cases where it is not quite encircled by the palate-bone.

According to the author, the connexion of the vomer, next in importance to that with the lateral masses of the ethmoid, is that with the intermaxillaries, which is constantly found when the mesial palatine processes of the intermaxillaries are developed, and is always of such a description that the groove formed by the superior margins of these processes is continuous with the vomerine groove, while their inferior margins likewise form a continuous line with the inferior margin of the vomer.

As to the connexion of the vomer with the central plate of the ethmoid, the author considers it altogether of secondary importance; for, while that with the lateral masses of the ethmoid takes place at a very early date, and is a connexion of continuity, *i. e.* by the bones lying edge to edge, that with the central plate is of late occurrence, and is one of contiguity, *i. e.* by the surfaces of the bones coming accidentally in contact. The connexions of the vomer with the maxillaries and palate-bones are also considered to be of secondary importance.

In reference to the peculiarities presented by the vomer and ethmoid in the human subject, the author endeavours to show that their relations are really in agreement with those which he has described as typical among mammalia. He found the key to the interpretation of the arrangement seen in the adult, by examining the condition of the bones in very early life, especially the sphenoidal spongy bones. The last-mentioned bones are described in young subjects as consisting of hollow pyramids enclosing the sphenoidal sinuses, but originally quite unconnected with the sphenoid. They articulate on the one hand, edge to edge with the alæ of the vomer, and on the other with the ethmoid and the palatals, and by their contact with the orbital and sphenoidal processes of the latter, complete on either side the so-called sphenopalatine foramen, and correspond altogether to the ethmovomerine laminæ and part of the ethmoid in other mammals.

The human vomer can be seen in its perfection as a separate bone, and with all its connexions fully developed, in early life only; and an explanation is offered of the peculiarities of the human vomer and ethmoid, by showing that they are consequences of the great curvature of the cranial arch, the small development of the organ of smell, and the prolongation of the face downwards for the sake of voice, instead of forwards as in other animals, for the sake of prehension.

The connexions of the vomer, ethmoid, and intermaxillaries in the various families of mammals are next examined in detail, and various differences of form, &c. peculiar to genera and orders are noticed. Attention is particularly drawn to the circumstance that in the camels and other ruminant families the intermaxillaries are prolonged forwards beyond the points of junction of their lateral plates and mesial palatine processes, so as to embrace more or less completely the anterior extremity of the septal cartilage of the nose, which between these prolongations dips into the palate; and that, similarly, the intermaxillaries meet above the septal cartilage in the Dugong, Manati, and Tapir, in which they have no mesial palatine processes: to these forms importance is afterwards attached in comparing the intermaxillaries of mammals with those of birds, reptiles, and fishes.

The author argues that the vomer, lateral masses of the ethmoid, and palate-bones are members of one segment; that the central plate of the ethmoid is the centrum of the segment behind; and that the mesial palatine processes of the intermaxillaries play the part of cen-

trum to the segment in front of the vomer. He considers the skull to be composed of seven segments; that three of these are developed for protection of the encephalon, viz. posteriorly the occipital segment, then the parietal segment, to which belong the postsphenoid and parietals, and anteriorly the frontal segment, to which the frontal and central plate of the ethmoid belong; and that three other segments with imperfect neural arches, and each connected with a special sense, alternate with the first three, viz. the auditory, optic, and olfactory segments, the last-mentioned being the vomerine segment; and that foremost of all is a terminal seventh segment, the facial segment, to which the intermaxillaries, maxillaries, and nasals belong.

With a special view towards determining the exact construction of the facial segment, he examines the anterior portions of the skulls of birds, reptiles, and fishes. Taking as his guide the constitution of the vomerine segment as he believes he has established it in mammals, he concludes that the vomer in birds, reptiles, and fishes is the bone described as such by Professor Owen; that the lateral masses of the ethmoid are the prefrontals of reptiles and fishes, and are absent from the skull of birds; that the central plate of the ethmoid is represented by the interorbital septum (whether ossified or not) of birds, reptiles, and fishes; and that in fishes the nasals are represented by the nasal of Owen, which, however, usually contains an additional element, which plays the part of centrum, and corresponds to the mesial palatine processes of the intermaxillaries of other classes. His examination of the skulls of birds, reptiles, and fishes has convinced him that throughout the vertebrata the lateral plates of the intermaxillaries form the proximal part of a hæmal arch, of which the maxillaries compose the distal part, while the nasals are elements of the neural arch of the same segment; that thus in mammals the ring of bone surrounding the incisive foramina is the first hæmal arch; that the nostrils in all vertebrata are openings situated behind the facial and in front of the vomerine segment; and that the alar cartilages of the nose are structures serially homologous with the tarsal cartilages and the pinnæ of the ears.

In attempting to explain the exact morphological relations of the nasals, the author enters into the embryological bearings of the conclusions at which he has arrived, and puts forward the hypothesis

that the anterior segments of the skull tend to undergo fission in the direction of the axis of the chain of segments, and that the cleft separating the maxillary lobe of the embryo from the middle and lateral frontal lobes is morphologically horizontal—lying between the hæmal and neural elements of more than one segment; and in proof of this view a variety of evidence is adduced.

II. "On the Structure and Growth of the Tooth of *Echinus*." By S. James A. Salter, M.B. Lond., F.L.S., F.G.S. Communicated by Thomas Bell, Esq. Received March 5, 1861.

(Abstract.)

The author commences his paper by stating that the researches upon which it is based were made more than four years since, and then without the knowledge that the structure had been previously investigated by others.

An abstract of the *literature* of the subject (contained in very narrow limits) is then given.

In 1841 Valentin, in Agassiz's Monograph on the Echinoderms (*Anatomie des Echinodermes*), published a description and many good figures of the minute anatomy and growth of the Echinus-tooth.

Professor Quekett, in his 'Lectures on Histology' (1854), referring to the minute *mature* anatomy of the organ, states its ultimate structure to resemble bone and dentine of vertebrata.

Dr. Carpenter, in his work 'On the Microscope,' speaks of the tissue of the tooth as essentially of the same nature as the shell of the Echinidæ generally (1856).

Lastly, Professor W.C. Williamson describes the subject more fully than his predecessors, entering into the question of the development of the tooth both generally and histologically (though apparently in ignorance of Valentin's Essay), in a paper on the "Histology of the Dermal Tissues," &c., in the British Journal of Dental Science, 1857.

The coarse anatomy and relations of the Echinus-tooth are then described, and the question is discussed as to how far the organ resembles and how far it does not resemble the incisor tooth of a Rodent mammal, to which it has constantly been likened.